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THE SPELLING AND PRONUNCIATION OF CHEMICAL TERMS.

BY THOMAS H. NORTON, PROFESSOR OF CHEMISTRY, UNIVERSITY OF CINCINNATI.

THE necessity of establishing standards with reference to the nomenclatures of the different provinces of science has been felt for several years past, with more or less force, according to the branch concerned. In geography our own government has taken a most desirable initiative by issuing authorized lists of geographical names, the spellings of which have been the result of careful study and adherence to a few fixed general rules. Much has been done of late towards the establishment of a uniform nomenclature in geology, while the botanists assembled in an international congress this fall to grapple with their phase of the problem. In medicine the necessity of standards for uniformity in pronunciation is felt most keenly, but no decisive steps have been taken. It is by no means uncommon for students in a medical or pharmaceutical college to hear widely divergent pronunciations on the part of the corps of instructors.

The existence of these diversities, not only in medicine but also throughout the whole range of the sciences, is due chiefly to two causes. The first is the radical change which has taken place in the pronunciation of the classical tongues during the past quarter of a century, and which has naturally exerted a powerful influence on the pronunciation of naturalized Greek and Latin terms as well as of most derivatives from these languages. The second cause is to be found in the effects of Continental — i.e., French and German — usage on the constantly-growing contingent of American scientific and professional men who have studied in European universities. Involuntarily they often retain the Continental pronunciation of the vowels — especially *i*, in a less degree *a* and *e*, and still less *o* and *u* — in the use of words of identical or similar spelling. When this happens in the case of instructors, their usage is of course widely imitated.

Among our chemists, the need of adopting standards has been felt chiefly in the following directions.

1. The rapid extension of organic chemistry has led to the discovery of a notable array of new classes of compounds, whose existence was totally unforeseen and for whose naming, naturally, no provision was made, when about thirty years ago our otherwise admirable system of nomenclature was introduced by Hofmann and his contemporaries. This problem is, of course, one essentially international in its nature, and is now fortunately in a fair way to be solved. At the Chemical Congress, held in connection with the Paris exposition of 1889, an able committee was appointed to carefully formulate the questions needing decision, and make suggestions as to their treatment. As the complement of their work a congress of representative chemists was held during the past summer at Geneva, that favorite meeting-place of international conferences, and the great majority of the questions were settled in a series of sixty-two rules adopted with practical unanimity. Time limitations prevented the completion of the work, which is postponed to an adjourned session. It is impossible here to go into detail upon the important results of this congress. Suffice it to say that it has, with reasonable simplicity and deference to existent usage, provided a nomenclature which will meet the needs of chemists for probably 20 or 30 years. The chemist's language is not unlike that of the Turk, in which growth and change occur so rapidly that each new generation requires a totally revised and modernized edition of standard works in order to render them fairly intelligible to the reading public.

2. A settlement of the claims of priority in the case of the names of two elements, Columbium (or Niobium) and Glucinum (or Beryllium), seemed eminently desirable.

3. Equally important seemed to be the adhesion to several decisions on minor questions in terminology, such as that of the alcohols, the use of *-ic*, etc., already adopted by the London Chemical Society.

4. A subject of prime importance was the adoption of some fixed spelling and pronunciation for certain terminations, notably *-in* and *-ine*, *-id* and *-ide*, which would effectually banish the present lack of uniformity and adherence to the ordinary laws governing word-building and pronunciation in our language.

5. It seemed also proper to ascertain how far the chemist can go in adopting the simpler forms of spelling advocated by the Philological Societies of Great Britain and America, availing himself of the resultant economy and keeping in touch with the evident steady progress of phonetic reform in the English language.

For the purpose of obtaining a consensus of opinion and ultimate decision on the part of American chemists with reference to the four latter topics, the Chemical Section of the American Association for the Advancement of Science appointed in 1887 a special committee, which later, on account of the importance of the subject, was made one of the standing committees of the Association. Since that time the members of the committee have been in active correspondence with the entire body of American chemists and leading philologists, by means of annual circulars and individual communications, while at the successive meetings of the association the subject has been a regular topic for discussion. The final report, embodying the results of these few years of work, and approved unanimously by the Chemical Section of the Association, has recently appeared in print and been widely disseminated.

The importance of obtaining uniform usage in the application of these rules has been so fully recognized that the Bureau of Education at Washington is issuing an edition in the form of a small wall-chart, to be distributed to high-schools and colleges, which can thus keep the authority constantly in view in lecture-room and laboratory.

It might be added that the chemical nomenclature of one of the largest dictionaries in our language, now in course of preparation, is based upon this simple code, which has likewise been adopted by the influential *Journal of Analytical and Applied Chemistry*, and also used by Dr. T. Sterry Hunt in his latest work upon "Systematic Mineralogy," and in Professor R. A. Witthaus's recent "Manual of Chemistry." Since the appearance in print of this synopsis of rules, the writer and other members of the committee have received frequent inquiries with regard to the exact reasons underlying one or another of the individual changes recommended. These inquiries have come from those who have lacked the opportunity to keep *au courant* with the progress of the discussion and the final decisions.[1] It may, therefore, meet a

[1] This lack of general information on the subject and familiarity with the careful, cautious and conservative spirit in which all suggestions of change have been made, is well illustrated in a recent communication to this journal (p. 247). In this the writer, having encountered *sulfate* demands why *phenolphtalein* does not also undergo change, and then seeks to "picture our laboring scientists, with the new-system dictionary before them, ever fearful of beginning one word with an *F* after the new, and the next with a *Ph* after the old system." He is evidently unconscious of the one fact that the simplified spelling of *sulfur* and its derivatives, while bringing us into touch with the elementary principles of phonetic reform in our own language has much broader claims on us because it so manifestly aids all users of dictionaries and indexes in English, French, German and Italian. He likewise overlooks the fact that for the same reason the *Ph* of phosphorus remains intact because Italian is thus far the only language in which the digraph has been superseded by the simple *F*, and because the change in the initial letter of a word would lead to difficulties in the matter of reference, undesirable at present.

direct need on the part of many, especially non-chemists, to have a brief summary of the reasons for the rules which have evoked the most inquiry placed in a journal reaching all classes of those interested in the progress of science.

The most important decisions may be classified under the following heads: —

1. *Elements.* — CESIUM. This shortened form for *cæsium* brings us into harmony with the French *césium*, and the Italian *cesio*, and is in accord with the prevalent reform in the use of diphthongs.

ALUMINUM. This shortened although less euphonic form meets the wishes of technical chemists, and is desirable in view of the growing industrial use of the metal.

COLUMBIUM. This replaces *niobium* as a matter of historical justice. It seems important that the one element discovered and named by an American chemist should retain the patriotic appellation first assigned it.

GLUCINUM is preferred to *beryllium* on the same ground of historical priority.

SULFUR. This is modified in accordance with the general phonetic change going on in our language, and the change is extended to all the derivatives. It is a reform which brings us into accord with the French *sulfure*, *sulfite*, etc., the German *sulfat*, *sulfid*, etc., and the Italian *zolfo* or *solfo*, *solforico*, etc. It might naturally be asked, Why not extend this reform to phosphorus? The reasons are here by no means so strong as in the case of sulfur. While the Italians use *fosforo*, the French and Germans still retain the *ph*, as *phosphore*. Again, the change would affect the initial letter — a serious matter in indexing.

2. ARSIN, STIBIN, PHOSPHIN, HYDROGEN-SULFID, etc. These shorter terms, which have long since received the stamp of authoritative usage, displace completely henceforth their cumbersome synonyms, *arsenetted hydrogen*, etc. It is hoped that the simplification may soon be carried still farther by the introduction of *sulfin*, *selenin*, and *tellurin*.

3. GRAMME. At first sight the retention of the long French form might seem inconsistent with the principles of phonetic reform actuating the changes already enumerated. It is, however, dictated by strong prudential reasons, as long as the metric system is used side by side with the old series of apothecaries' weights in medicine. As soon as the transition period is over and the latter system is effectually displaced, the simpler form will unquestionably be adopted. Such is the similarity both in sound and spelling between *gram* and *grain*, that it is evident how easily mistakes of the gravest nature could occur either in following written or verbal directions, especially in this era of telephones. It is a matter of record that several deaths have already been caused by the omission of the dot over the *i* in *grain* or by mere inadvertence.

4. Derivatives of VALENCE. In their formation the Latin prefixes are used invariably instead of the Greek, this being thoroughly in accord with the recognized principles of word-building in our language.

5. The termination -OL. This is used exclusively for alcohols, and all single names for alcohols receive the termination. This is in harmony with British usage and conduces to a most desirable uniformity and simplification. The chief difficulty in the application will be found in the use of glycerol for glycerin; but as this has been overcome in England, it certainly can be in this country.

6. The termination -IC. This is used for metals only, where there is a contrast with *-ous*, as in *ferric*, *mercuric*, *cupric*, etc., avoiding such forms as strontic, aluminic, zincic, ammonic, etc. The rule brings us, also, into accord with transatlantic usage and eliminates several unnecessary and far from euphonious terms.

7. The termination -IN. The changes recommended in this connection are perhaps the most far-reaching and the most subject to discussion. They involve the dropping of the final *e* from the names of all chemical elements and compounds formerly ending in *-ine*, und the uniform pronunciation of the final syllable with the short *ĭ*, as chlorin, amin, anilin, quinin, cocain. The only exception to this rule is in the case of the group of doubly unsaturated hydrocarbons (butine, heptine, hexine, pentine, propine, etc.), which still retain the final *e* and the long sound of *ī*. The chief objection to this rule is the fact that some years since Watts and others proposed the use of the termination *-ine* for basic substances and the limitation of the termination *-in* to certain neutral compounds, viz., the glycerids, glucosids, proteids, and bitter principles. In this latter category are found also the so-called resinoids introduced by the eclectics, and obtained by precipitating the alcoholic extract of a drug with water.

In considering the force of the objections that may be raised against the change, it must be admitted at the outset that there is an undeniable value in the consistent use of distinctive suffixes for distinct classes of compounds; provided, however, that the use of any given suffix is limited to a single class, that there is a phonetic difference as well as a visible difference between closely allied terminations, and that there is no serious violation of established usage in word-building. Illustrations of such helpful uniformity are to be found in the terminations of the various series of hydrocarbons, of the alcohols, etc. In examining how far these conditions prevail in the use of these terminations, we note that —

a. The use is not limited to a single class in the case of either *-in* or *-ine*. *b.* There is little or no accompanying phonetic difference, the *i* being almost invariably short. *c.* The final *e*, as a rule, when following a single consonant, should indicate the long sound for the preceding consonant (Webster's Dictionary, "Principles of Pronunciation," p. xlv.), which is not here the case. *d.* The usage would demand a very extensive and accurate knowledge of the constitution of a large number of compounds. *e.* It has been adopted by but a portion of the chemical world; few are consistent in its use; by many it has never been recognized. *f.* In the case of the resinoids, the existing possibility of danger as a result of confusion between, say, *aconitin* and *aconitine*, is but slightly helped by the presence of the final *e*, as will be easily acknowledged by anyone familiar with many specimens of handwriting, especially of physicians' handwriting, and as far as the ear is concerned remains unaffected — a most important consideration in view of the prevalent use of the telephone for ordering prescriptions.

It would seem eminently desirable for those most closely associated with the progress of pharmacy to counsel at once the abolition of this existing nomenclature as applied to the resinoids by introducing distinctive prefixes or additive terms, so as to remove entirely all possibility of confusion. An able writer in a recent article in the *American Druggist* (vol. xxi, p. 15) states: "But though they (the resinoids) are gradually going out of use, some of them are still in demand, and fatal results might ensue if both terms, that of the weaker resinoid, and that of the powerful alkaloid, were confounded." It may pertinently be inquired whether a reform, the value and utility of which is conceded by all, should be delayed by the effort to bolster up the weak fortifications about the terminology of a group of substances — not distinctive chemical compounds, but mechanical, commercial mixtures — when that terminology in its present state is confessedly a menace to human life.

The advantages accruing from the application of the new rule are, briefly stated, the following: *a.* The simplification, uniformity, and economy of time resulting from the use of a single spelling for the same sound. *b.* The unvarying use in the termination *-in* of the short *ĭ*, the sound now employed in the vast majority of cases, the one approximating most nearly to the European *i*, and the one thereby most helpful to foreigners using our language, and *vice versa*. *c.* The harmonizing of the practice governing the use of this termination with the principles underlying the general rules for the pronunciation of other chemical terminations. *d.* The falling into line in this regard with the general movement towards phonetic reform in our language. *e.* The accord with the general rule in our language governing the use of the final *e* and its effect on preceding vowels.

The termination -ID. This replaces in all cases *-ide* (as oxid, chlorid, sulfid), and the *ĭ* is invariably short. The reasons for this

rule are much the same as those enumerated in the above paragraphs. Of the three pronunciations of this termination *-īde, ĭde,* and *ĭde,* in varying degrees of usage amongst us, the second appeared undoubtedly to be the most preferable; *-īde* is an uncommon, almost unnatural, pronunciation of the vowel in English, although it would bring our usage into unison with that of European countries, and simplify phonetic values for the ears of foreigners; *-īde* leads frequently to confusion with *-īte,* and is the value of *i* farthest removed from European usage; *-ĭd* approximates closely to the Continental *i,* into which it is easily lengthened, is readily recognized by the foreign ear, is not confused with the termination *-īte,* is in line with present phonetic progress, and has the backing of authority and usage. The short sound of *i* naturally dictates the dropping of the final *e.* "According to Smart and Cull, chemical terms ending in *-ide* — as bromide, chloride, etc. — should be pronounced with the *i* long; but all other orthoëpists are unanimous in making the vowel short; and the propriety of the latter mode of pronunciation is established by the fact that this whole class of words is not unfrequently spelt without the final *e,* thus *bromid, chlorid*" (Webster's Dictionary, "Principles of Pronunciation," p. xliv.).

In conclusion, it may be said that the chemical section of the American Association recognizes the fact that there is still room for advancement in the path of phonetic reform, and that questions may still arise with regard to divergent usage or defects in existing rules. The task of collecting and collating such questions and of presenting them at a later date to the Association for action has been assigned to Professor Jas. Lewis Howe of Louisville, who will gladly receive all information, suggestions, or propositions pertinent to the subject from those interested in the perfecting of our chemical nomenclature.

BOSTON SCHOOL-BOYS.

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NUMEROUS results may be shown to flow from the excellently arranged data in the valuable memoir of Professor H. P. Bowditch on the Growth of Children (Twenty-Second Annual Report of the State Board of Massachusetts, Boston, 1891). Permit me to draw attention to two of them.

It is necessary to premise that the method was adopted by him of describing classes by means of eleven percentiles, but, for the present purpose, three are enough, namely, the 10th, 50th, and 90th. In other words, it is sufficient now to deal with the statures of the persons who occupy those posts in any class along whose length 100 posts have been marked at equal intervals. It follows that 10 per cent of the whole class are shorter than the 10th percentile and 90 per cent are taller. These conditions are reversed in respect to the 90th percentile; as for the 50th, it is the median value, which one half of the class falls short of and the other half exceeds. The median in most series differs little from the arithmetical mean, and may be used instead of it, as a serviceable standard of comparison.

The variability of a series may be measured by the difference between any two named percentiles. The wider these are apart the more is the scale magnified; on the other hand, the less trustworthy does the measure become. In the present series we can with propriety use the difference between the 10th and the 90th percentiles, but we cannot in all cases, owing to the paucity of data, use that between the 5th and the 95th; the former will therefore be here adopted as the measure of variability.

In order to compare on equal terms the variability in stature of growing boys at different ages we must so reduce their measures that the median shall in all cases be the same. It is customary for this purpose to take the median as 100, but there is more significance in the results when it is taken at a value that represents the average stature, or thereabouts, of male adults. Here it will be taken at 67 inches. In the following table the 10th and 90th percentiles for the several ages are those given by Bowditch, after multiplying them by 67, and then dividing the result by the median stature at that age.

Calculated from Tables by Bowditch of Heights of Boston School-boys.

Age last Birthday.	Of American Parentage.				Differences.	Of Irish Parentage.				Differences.
	Number of Cases.	Median.	Percentiles × (67 ÷ Median).			Number of Cases.	Median.	Percentiles × (67 ÷ Median).		
			10°	90°				10°	90°	
5	201	41.84	62.9	71.0	8.1	366	41.70	63.3	71.2	7.9
6	342	44.00	63.5	71.1	7.6	503	43.90	63.3	70.7	7.4
7	369	46.36	63.5	70.9	7.4	562	45.68	63.5	70.9	7.4
8	407	48.34	63.2	70.9	7.7	588	47.80	63.6	70.6	7.0
9	381	50.07	63.5	71.2	7.7	556	49.61	63.7	70.9	7.2
10	360	52.24	62.7	70.5	7.8	571	51.62	63.6	71.1	7.5
11	350	54.14	62.5	70.5	8.0	548	53.17	63.4	70.6	7.2
12	373	55.68	63.4	72.2	8.8	497	54.89	63.2	70.9	7.7
13	391	58.14	62.3	71.8	9.5	463	56.58	63.7	71.9	8.2
14	386	60.77	62 6	72.8	10.2	334	58.81	63.3	71.5	8.2
15	342	63.17	62.3	71.4	9.1	155	60.98	63.0	71.9	8.9
16	232	66.03	62.5	69.9	7.4	61	64.42	(61.8)	(70.4)	(8.6)
17	128	69.39	63.2	71.0	7.8	26	Too few.			(?)

On examining the columns of differences, we find a remarkable increase in the differences between the 10th and 90th percentiles during the interval between the ages of 11½ and 15½ years; that is, of boys who at their last birthday were 11 or 15 years old. The period in question is that during some portion of which the growth is apt to be temporarily accelerated, but the precise epoch of acceleration differs; some boys being more precocious than others. Consequently the variability among boys of the same age, between the ages of 11½ and 16½ years, is greater than at other times. The point to which I wish now to direct attention, is the much greater variability during this period of the children of Americans than of those of Irish, for which it seems difficult to account. It can hardly be owing to variations of nurture, because its influences would probably be greatest on those classes who were least assured in their habits of life; now it is difficult to suppose that the Irish in Boston are, as a class, better established and more well-off than the Americans. As regards the effects of race, it is true that the Americans are more mixed in origin than the Irish, but we should have expected purity of race to manifest itself by a reduced variability at all ages, and not only at the particular period we are considering. However, it seems to be otherwise, and that the great variability of American children at the time in question may really be due to their mixed ancestry. In confirmation of this variability being a racial effect, we note how much earlier the epoch of its increase sets in among the children of Americans than among those of Irish, the difference amounting to at least one year. Anyhow, these statistics suggest the possible existence of an hitherto unobserved physiological difference between the children of the Americans and of the Irish, which might repay investigation.

A considerable agreement will be found in the figures contained in each of the four columns of percentiles in the table; their variations ranging through 1.2, 1.9, 0.7, and 1.3 inches, respectively. In other words, they range between limits that are hardly more than one inch on the average apart, while of course the range in other percentiles that are nearest the median is progressively smaller, till at the median itself the range is *nil.* There is, therefore, a fair approximation towards constancy in the ratio between any given percentile and the corresponding median that holds good for all these ages. It follows that if we are given all the eleven percentiles of stature that are found in Bowditch's memoir, together with the median heights for the several successive ages, we should have sufficient data to reproduce, in a roughly approximate way, the entire table of distribution of growth. The variability and the median are not such independent